

CLAIMS

What is claimed is:

- 1 1. A method for detecting characteristics of an object, the method comprising:
 - 2 identifying a projection array used to project coded light onto a scene containing the
 - 3 object, wherein the projection array comprises a plurality of projection elements;
 - 4 obtaining an image of the scene with the coded light projected onto it;
 - 5 identifying a plurality of image elements forming an image array from the image; and
 - 6 for each image element, determining correspondence information that can be used to
 - 7 determine which projection element in the plurality of projection elements corresponds to
 - 8 that image element, wherein determining correspondence information for each element is
 - 9 performed independently of knowing correspondence information for any other image
 - 10 element.
- 1 2. The method of claim 1, further comprising:
 - 2 determining position information for each identified image element based at least in
 - 3 part on the correspondence information for that image element.
- 1 3. The method of claim 1, further comprising:
 - 2 determining position information for each identified image element based at least in
 - 3 part on the correspondence information for that image element and on a position of a
 - 4 projector that supplies the projection array relative to a camera that obtains the image array.

1 4. The method of claim 1, wherein determining correspondence information includes:
2 determining a row coordinate and a column coordinate in the image array for one or
3 more image elements based at least in part on a row coordinate and a column coordinate in
4 the projection array.

1 5. The method of claim 1, wherein determining correspondence information includes:
2 determining a row coordinate and a column coordinate in the image array for one or
3 more image elements; and
4 for each of the one or more image elements, determining a row coordinate and a
5 column coordinate for an element in the projection array that corresponds to that image
6 element.

1 6. The method of claim 1, wherein the step of determining correspondence information
2 is performed without having to first determine correspondence information for an element in
3 the plurality of image elements that is designated as calibrating the correspondence
4 information for all other image elements in the plurality of image elements.

1 7. The method of claim 1, wherein the step of determining correspondence information
2 is performed without having to first determine correspondence information for an element in
3 the plurality of image elements that is designated as being a first element in a sequence of
4 elements that correspond substantially to an entire row of elements in the projection array.

1 8. The method of claim 1, wherein the step of determining correspondence information
2 includes identifying missing image elements by identifying one or more projection elements
3 that have no corresponding image element in the image array.

1 9. The method of claim 8, further comprising the step of compensating for the missing
2 image elements by using image elements that are congruent to the missing image elements.

1 10. The method of claim 1, wherein identifying a projection array includes identifying
2 data representing a tangible medium used to pattern light emitted from a projector.

1 11. The method of claim 1, wherein identifying a projection array includes identifying
2 data representing a diffraction pattern for structuring light emitted from a projector.

1 12. The method of claim 1, further comprising the step of projecting coded light onto the
2 scene to create a pattern of elements having a detectable characteristic belonging to a set of
3 two or more characteristic, wherein the pattern of elements is created from the projection
4 array.

1 13. The method of claim 12, wherein each of the characteristics in the set is a geometric
2 characteristic that is distinguishable from an other geometric characteristic in the set.

1 14. The method of claim 12, wherein each of the characteristics in the set is a color that is
2 distinguishable from an other color in the set.

1 15. The method of claim 12, wherein each of the characteristics in the set is a shape that
2 is distinguishable from an other shape in the set.

1 16. The method of claim 12, further comprising:
2 determining a sequence of values that can identify each of the projection elements in the
3 projection array;
4 assigning a value used in the sequence to each characteristic in the set of two or more
5 characteristics; and
6 wherein the step of projecting coded light includes projecting each projection element in the
7 projection array as one of the characteristics in the set of two or more characteristics
8 so that the sequence can be at least partially reflected in the pattern based on the value
9 assigned to each characteristic.

1 17. The method of claim 16, wherein assigning a value used in the sequence includes
2 assigning a binary value.

1 18. The method of claim 16, wherein determining a sequence of values includes
2 determining the sequence comprising non-repeating binary values.

1 19. The method of claim 18, wherein determining the sequence includes using a non-N-
2 repeating bit assignment formula.

1 20. The method of claim 18, wherein determining the sequence includes assigning a
2 subset of the sequence to individual column coordinates in order to correspond elements in
3 the projection array with elements in the image array.

1 21. The method of claim 12, wherein projecting coded light onto the scene to create a
2 pattern of elements includes creating the pattern so that the detectable characteristics identify
3 columns in the projection array and so that each row in the projection array has the same set
4 of columns.

1 22. The method of claim 12, wherein projecting coded light onto the scene to create a
2 pattern of elements includes creating the pattern so that the detectable characteristics identify
3 columns in the projection array and so that the columns are repeated in a staggered
4 arrangement.

1 23. The method of claim 22, further comprising determining which projection elements in
2 the projection array have no corresponding image element using the staggered arrangement.

1 24. The method of claim 21, further comprising determining which projection elements in
2 the projection array have no corresponding image element by identifying which rows in the
3 image array do not have the same columns.

1 25. The method of claim 1, wherein one or more steps of the method are performed by
2 one or more processors executing instructions stored on a computer-readable medium.

1 26. A method for creating a light pattern on a scene, the method comprising:
2 creating a sequence of values comprising a plurality of subsequences, wherein each
3 subsequence identifies one or more elements of a projection array independent of any other
4 element in the projection array;

5 assigning a value to a characteristic in a set of optically distinguishable
6 characteristics;

7 projecting light in a pattern in order to create at least a portion of the pattern on the
8 scene, wherein the sequence is encoded into the pattern based on the value assigned to each
9 characteristic in the set.

1 27. The method of claim 26, wherein each of the characteristics in the set is a geometric
2 characteristic that is distinguishable from an other geometric characteristic in the set.

1 28. The method of claim 26, wherein each of the characteristics in the set is a color that is
2 distinguishable from an other color in the set.

1 29. The method of claim 26, wherein each of the characteristics in the set is a shape that
2 is distinguishable from an other shape in the set.

1 30. The method of claim 26, wherein assigning a value used in the sequence includes
2 assigning a binary value.

1 31. The method of claim 26, wherein creating a sequence of values includes determining
2 a sequence comprising non-repeating subsets of binary values.

1 32. The method of claim 31, wherein determining the sequence includes using a non-N-
2 repeating bit assignment formula.

1 33. The method of claim 26, wherein creating a sequence of values includes assigning a
2 subset of the sequence to individual column coordinates in order to correspond elements in
3 the projection array with elements in the image array.

1 34. The method of claim 26, wherein one or more steps of the method are performed by
2 one or more processors executing instructions stored on a computer-readable medium.

1 35. A system for detecting characteristics of an object, the system comprising:

2 a projector configured to project coded light that is created from a projection array
3 onto a scene containing the object, wherein the projection array comprises a plurality of
4 projection elements;

5 a camera system to capture an image of the scene with the coded light; and

6 a processor coupled to the processor and configured to:

7 determine correspondence information that can be used to determine which projection
8 element in the plurality of projection elements corresponds to a particular image element.

1 36. The system of claim 35, wherein the processor is configured to determine the
2 correspondence information independently of determining correspondence information for
3 other elements in the image array.

1 37. The system of claim 35, wherein the processor is configured to determine the
2 correspondence information independently of determining correspondence information for all

- 3 other elements in the image array except for a set of congruent image elements that include
- 4 the particular image element.